# OBSERVATIONS ON THE SNOW SCORPIONFLY *BOREUS BRUMALIS* FITCH (BOREIDAE: MECOPTERA) IN SUDBURY, ONTARIO

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*Quaestiones Entomologicae*
*15: 341-344 1979*

*Adults of the snow scorpionfly,* Boreus brumalis *Fitch, are common on the surface of snow from February to March within the city limits of Sudbury, Ontario when the temperature rises above 0 C. Ease of locating a mate and dispersal are the suggested reasons for this mid-winter activity.*

*Les adultes du Mécoptère* Boreus brumalis *Fitch sont communs sur la neige dans la ville de Sudbury, Ontario, en février et en mars, quand la température s'élève au-dessus de 0 C. Le fait que la rencontre des partenaires sexuels et la dispersion soient faciles est suggéré comme cause d'une telle activité hivernale.*

The occurrence of active insects on the surface of snow in mid-winter is to most biologists an extraordinary event. Snow scorpionflies of the genus *Boreus* exhibit this behavior as a regular part of their life cycle (Crampton, 1940; Byers 1954; Chapman, 1954; Webb *et al.*, 1975; Penny, 1977) and although they are not rare insects, they are seldom observed. This paper reviews the biology of *Boreus brumalis* Fitch and records the species on snow-covered hills within the city limits of Sudbury, Ontario (46°30′N, 81°00′W) in February and March of 1977 and 1978. Suggestions also are given as to why *Boreus brumalis* emerges onto the surface of the snow.

The Family Boreidae consists of two genera, *Boreus* and *Hesperoboreus* (Penny, 1977) with members of the genus *Boreus* occurring in Europe, Asia, and North America. Ten species of *Boreus* are recorded from North America with only two, *Boreus brumalis* and *Boreus nivoriundus* Fitch occurring east of the Rocky Mountains (Penny, 1977). *Boreus brumalis* is considered the most common North American species (Byers 1954). It is usually found in deciduous woodlands and has been recorded from central Ontario and Quebec south to Tennessee, with the western limits being isolated populations in Illinois, Wisconsin, and Minnesota (Webb *et al.*, 1975).

Both male and female *Boreus brumalis* are small (2.5 mm to 5.0 mm), stout, black insects with biting mouthparts on the ventrally extended rostrum, a characteristic common to the Order (Richards and Davies, 1977). The legs and antennae are long and black. Wings of the male are reduced to a pair of slender vestiges, tapering apically to an acute point (Fig. 1), with coarse black setae found along the lateral and medial margin. The hind wings are much smaller and lie in a groove in the fore-wing. The genital claspers are flexed dorsally over the abdomen giving the scorpion-like appearance. Wings of the female are further reduced to scale-like, oval lobes (Fig. 2). The functional ovipositor is elongated and consists of modified 9th to 11th abdominal segments (Cooper, 1940). For further details on the morphology of Boreidae, see Penny, 1977.

Both the immatures and adults of all species live in and feed on mosses. The eggs are laid in late fall at the base of mosses and the larvae hatch in about ten days (Webb *et al.*, 1975). Crampton (1940) reported that larvae can be found at all times of the year implying that larvae feed throughout the winter. The larvae form small chambers in compacted soil and it is thought that they aestivate throughout part of summer in these chambers (Fraser, 1943; Webb *et al.*, 1975). Descriptions of *Boreus* larvae and pupae are given by Withycombe (1922). Pupation occurs in the chambers (Fraser, 1943) and the pupal stage lasts from 4 to 8 weeks. Adults of the European species *Boreus hyemalis* (L) emerge in

late fall and are found crawling around on mosses (Withycombe, 1922; Fraser, 1943). Adults of the North American species also emerge in the fall with Illinois populations known to crawl onto the surface of the snow from November to April (Webb *et al.*, 1975). The adults presumably continue feeding on mosses beneath the snow throughout the winter. The adults feed by thrusting their rostrum into the young shoots of mosses, chewing off the apex, then eating down into the core (Fraser, 1943).

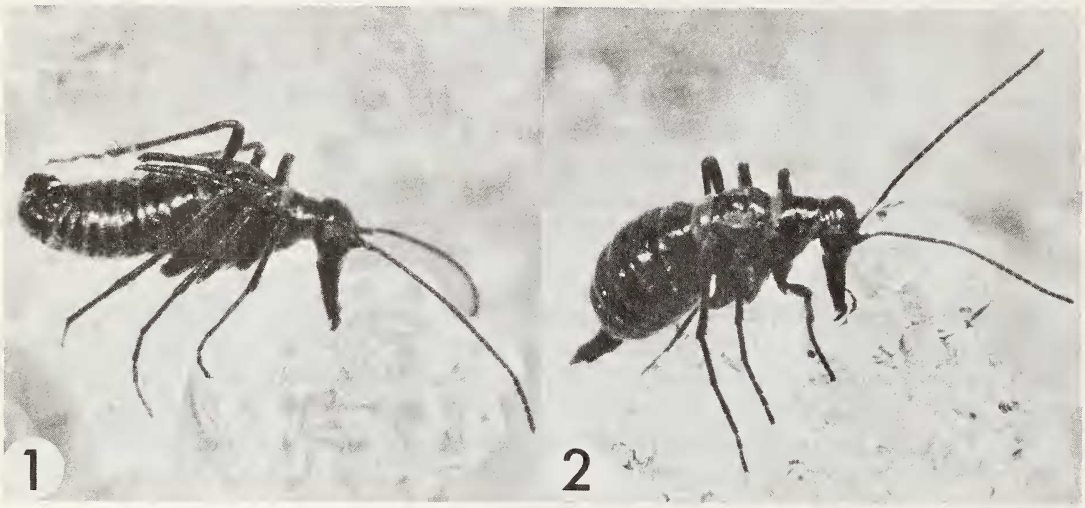


Figure 1 and 2. Fig. 1, Male *Boreus brumalis*. Fig. 2, Female *Boreus brumalis*. Magnification X 15.

The life cycle of *Boreus brumalis* in Sudbury is likely similar to that of *brumalis* in Illinois (Webb *et al.*, 1975). No adults were observed until mid-winter; however it is possible that some adults emerge in the fall and remain under the snow for several months before crawling to the surface. The first adults were found on 12 February 1977 and were common until 19 March on days with suitable temperatures. No adults were seen in 1978 before 4 March. Many copulating pairs were found indicating that oviposition also takes place in late winter.

Adults come to the surface along passage-ways found next to the stems of shrubs and trunks of trees. Apparently they only come to the surface when the air temperature approaches 0 C (Wojtusiak, 1950; Chapman, 1954), although one European species has been reported active at -5.5 C (Fjellberg and Greve, 1968). On 12 February 1977, the air temperature in Sudbury had risen to 2.3 C and on 19 March to 2.7 C, both being days that followed periods of subzero temperatures. The same occurred on 11 March 1978 when the temperature was 2.4 C. The adults were always most common and active aroung 1400 hours; however, they retreated beneath the snow around 1700 hours.

The sex ratio of the 107 specimens collected in Sudbury was 0.57, similar to that recorded for other species. (Fjellberg and Greve, 1968). Adults are easily spotted against the white snow and often were as common as 1 per $4m^2$. The largest populations were found in seral white birch-red maple-red oak forests on south-facing slopes (Fig. 3). The snow depth on dates of collection was about 30 cm.


Figure 3. Typical winter habitat of *Boreus brumalis* on a hillside dominated by white birch, red maple, and red oak within the city limits of Sudbury, Ontario.

The mating behavior of *Boreus* species is peculiar and has been described for several species (Cockle, 1908; Withycombe, 1926; Cooper, 1940; Crampton, 1940). The *Boreus brumalis* male upon finding a female, springs and seizes her body with his modified wings. Once she is securely gripped, the male uses his hind legs and claspers to manoeuvre her into a position parallel to and above his body. He then releases his wings allowing the female to flex her rostrum between his coxae, fold her antennae between her legs, and stretch her legs posteroventrally. Once in this position the male then grips her fore-legs and rostrum with his wings. This position with the female above the male is maintained throughout copulation. The male usually runs about during copulation while the female remains motionless.

The ability to remain active at low temperatures and to use the snow surface as a habitat is a fascinating adaptation shared by few other arthropods. Besides *Boreus*, only a few species of Chironomidae, Heleomyzidae, Tipulidae, Trichoceridae, Plecoptera, Collembola, and spiders have been reported using the snow surface (Wojtusiak, 1950; Hägvar, 1973; Hägvar, and Ostbye, 1973). Some spiders even form webs on the surface where they trap collembolans.

Little has been written as to reasons why scorpionflies climb to the surface in mid-winter. The obvious benefit would be ease of movement since the smooth surface of snow provides an alternative terrain with few impediments to dispersal. Some individuals were observed hopping a distance of 2 m in 5 minutes, while one was found 70 m from shore on a snow covered lake, obviously far from its site of emergence. Ease of locating the opposite sex also would be enhanced in this environment while the risk of attack by predators would be reduced. Some spiders were found on the surface at the same time as the Sudbury *Boreus*, but they were not observed feeding.

The temperature of the subnivean air space remains near 0 C with about 30 cm of snow cover, regardless of the external air temperature (Coulianos and Johnels, 1962) and this is obviously sufficiently warm for scorpionflies to locate stems and tree trunks and climb to the surface. Once on the surface their dark coloration would absorb heat thus raising the body temperature higher than it would

have been under the snow. This additional heat probably contributes to their improved ability to disperse on the snow surface. How they get back under the protective snow cover when the air temperature drops and the cue for their return remain as fascinating problems.

Although members of the genus *Boreus* are excellent candidates for further studies of cold hardiness, their greatest value may come from serving educators with another intriguing example of insect adaptability. Educators and biologists alike should be on the alert for winter insects since they vividly contradict the common misunderstanding that all in the insect world is inactive from October to April.

I thank M. Derro for his help in making the plates and G.M. Courtin for his comments on the manuscript. This paper was supported in part by NSERC grant number A0230.

## REFERENCES

Byers, G.W. 1954. Notes on North American Mecoptera. Entomological Society of America Annals 47: 484–510.

Chapman, J.A. 1954. Observations on snow insects in Western Montana. The Canadian Entomologist 86: 357–363.

Cockle, J.W. 1908. The mating of *Boreus californicus*. The Canadian Entomologist 40: 101.

Cooper, K.W. 1940. The genital anatomy and mating behavior of *Boreus brumalis* Fitch (Mecoptera). American Midland Naturalist 23: 354–367

Coulianos, C.-C. and A.G. Johnels. 1962. Note on the subnivean environment of small mammals. Arkiv Für Zoologi 15: 363–370.

Crampton, G.C. 1940. The mating habits of the winter mecopteron *Boreus brumalis* Fitch. Psyche 47: 125–128.

Fjellberg, A. and L. Greve. 1968. Notes on the genus *Boreus* in Norway. Norsk Entomologisk Tidsskrift 15: 33–34.

Fraser, F.C. 1943. Ecological and biological notes on *Boreus hyemalis* (L) (Mecopt. Boreidae). Journal of the Society for British Entomology 2: 125–129.

Hägvar, S. 1973. Ecological studies on a winter-active spider *Bolyphanthes index* (Thorell) (Araneida, Linyphiidae). Norsk Entomologisk Tidsskrift 20: 309–314.

Hägvar, W. and E. Ostbye. 1973. Notes on some winter-active Chironomidae. Norsk Entomologisk Tidsskrift 20: 253–257.

Penny, N.D. 1977. A systematic study of the Family Boreidae (Mecoptera). The University of Kansas Science Bulletin 51: 141–217.

Richards, O.W. and R.G. Davies. 1977. Imms' General Textbook of Entomology. Tenth Edition. Volume 2: Classification and Biology. Chapman and Hall, London. 421–1354.

Webb, D.W., N.D. Penny and J.C. Marlin. 1975. The Mecoptera, or scorpionflies of Illinois. Illinois Natural History Survey Bulletin 31: 251–316.

Withycombe, C.L. 1922. On the life-history of *Boreus hyemalis* L. Entomological Society of London, Transactions 1921: 312–318.

Withycombe, C.L. 1926. Additional remarks upon *Boreus hyemalis* L. Entomologist's Monthly Magazine 62: 81–83.

Wojtusiak, H. 1950. The temperature preferendum of winter insects of the genus *Boreus* (Panorpatae) and *Chionea* (Diptera). Academie Polanaise des Sciences et des Lettres. Bulletin International. Series B. 11: 125–143.